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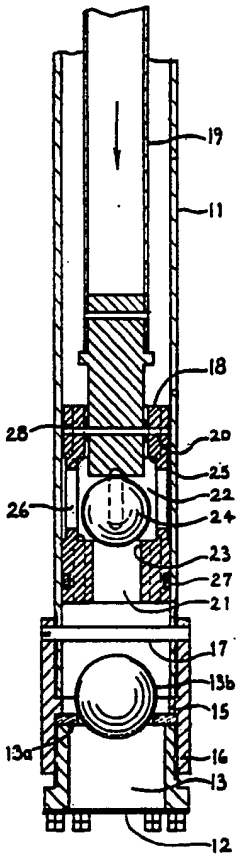
(54) Title: BORE HOLE PUMP

(57) Abstract

A bore hole pump comprises a tubular body (11) and a piston (18) provided with a seal (27) for sliding and sealing engagement with the inner wall of the tubular body (11) to thereby define a pumping chamber. The piston (18) accommodates a non-return valve (24, 23) which permits the pumped liquid to enter the piston through a passageway (21) before flowing through the space between the outer surface (25) of the piston (18) and the inner wall of the tubular body (11) into the body downstream of the piston (18). The space provides a restricted passageway whereby the liquid flowing therethrough is sufficiently turbulent to prevent any suspended particles in the pumped liquid from settling in the space during reciprocation of the piston (18).



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BORE HOLE PUMP

THIS INVENTION relates to piston pumps for pumping liquids.

It is an object of this invention to provide a pump which is able to pump liquids containing suspended particles and is able to maintain such particles in suspension which prevent them from settling between the portions of the pump undergoing relative reciprocation to each other and in order to minimise any abrasive effects of such particles.

In one form the invention resides in a pump having a pump body a piston slidably received therein to define a pumping chamber whereby the volume of the pumping chamber is varied with reciprocation of the piston in the pumping chamber, a seal supported by the piston for sliding and sealing engagement with the pump body, said piston accommodating a non return valve which allows the flow of liquid through the piston when the volume of the pumping chamber is being reduced by movement of the piston and which delivers liquid from the pumping chamber into a space between a piston and the internal walls of the pump body downstream from the seal, said space providing a restricted passageway opening into the pump body downstream from the piston whereby the liquid flow through the space during reciprocation of the piston is turbulent and of relatively high velocity.

According to a preferred feature of the invention the piston is pivotally mounted to the end of a pull rod.

According to a further preferred feature of the invention the outer wall of the piston is concentric to the internal wall of the pump body.

According to a further preferred feature of the previous feature the piston is formed with a central axial passageway which accommodates the non return valve, the outer face of the piston is formed with a waisted portion downstream from the seal and has a first set of openings provided in the waisted portions to communicate with the downstream side of the one way valve and the second set of passageways formed in the piston body downstream from the waisted portion to permit fluid flow from the waisted portion.

According to a further preferred feature of the previous feature said second passageways comprise at least one flute in the outer face of the piston body downstream from the waisted portion.

According to a further preferred feature of the invention the pump comprises a bore hole lift pump.

According to a further preferred feature of the invention the pump body is formed by the lower end of the riser pipe accommodating the pull rod and through which the liquid exiting the pump is raised.

According to a further preferred feature of the invention the pull rod is buoyant in the liquid.

According to a further preferred feature of the invention the pull rod has a cross sectional area which occupies a significant portion of the cross section area of the tube.

According to a further preferred feature of the invention the pull rod is tubular.

In another form the invention resides in a piston of a lift pump said piston having a substantially tubular configuration and having an external configuration similar in shape to the internal configuration of the pump body but being of reduced dimensions, one end of the piston being adapted to be pivotally mounted to a pull rod and to provide a clearance between the pull rod and the internal face of the piston the other end of the piston supporting around its exterior a seal adapted for sliding sealing engagement with the pump cylinder wall and at its interior a valve seat, a ball valve received within the body between the valve seat and the pull rod and apertures provided through the walls of the piston between the seal and the one end thereof.

The invention will be more fully understood in the light of two specific embodiments. The description is made with reference to the accompanying drawings of which:

Figure 1 is a sectional elevation of a pump of the first embodiment during the downstroke of the piston;

Figure 2 is a sectional elevation of a pump of the first embodiment during the upstroke of the piston;

Figure 3 is a sectional elevation of a pump according to the second embodiment during the downstroke of the piston; and

Figure 4 is a sectional elevation of a pump of the second embodiment during the upstroke of the piston.

The first embodiment is directed to a bore hole pump comprising a tubular body 11 which is provided by the end of casing or the return tube for the pump. The lower end of the body supports a screen 12 which provides the inlet to the pump and a non return valve 13 which is formed by an annular seat 13a clamped between an annular support 14 for the screen 12 and internal rib 15 provided on an annular support collar 16 fixed to the lower end of the tubular body 11. A ball valve 13b is accommodated within the inner end of the tubular body 11 and seats against the internal face of the valve seat 13a and is retained therein by at least one stop member 17 which comprises a rod extending diametrically across the lower end of the tubular body and supported from the collar 16. The pump body accommodates a substantially cylindrical piston 18 which is mounted at one end to one end of the pull rod 19 by means of a pivot pin 20 whereby the piston 18 is pivotable on the end of the pull rod about a transverse axis thereof. If desired the pivotal mounting provided by the pivot pin 20 may be replaced by any other suitable form of pivotal interconnection. The piston 18 is formed with a central axial passageway 21 extending between the ends of the piston and formed with an enlarged central chamber 22 within the piston. The central chamber accommodates a ball valve 24 which seats against a valve seat 23 provided at the upstream side of the central chamber to provide a one way valve in the piston.

The exterior of the piston at the other end supports a ring seal 27 which may take any desirable form such as an O ring or a lip seal or both. Downstream from the seal 27 the external face of the piston opposite the central chamber is formed with a waisted portion 25 and slot shaped apertures 26 are provided in the side walls between the central chamber 22 and the waisted portion 25. The

resultant annular rib 28 which is formed at the one end of the piston downstream from the waisted portion 25 is formed with several axial flutes (not shown) which extend between the waisted portion 25 in the downstream end of the piston. The flutes provide flow passageways between the waisted portion and the one end of the piston and may or may not be located in alignment with the apertures 26 in the side walls of the piston.

During downstroke of the piston as shown at Figure 1 the restricted flow pathway defined by the space between the waisted portion 25 of the piston and the side walls of the pump body and the flutes serve in creating a liquid flow therethrough which is both turbulent and of a relatively high velocity. As a result any suspended particles carried by the liquid are maintained in suspension and are carried away from the regions of engagement between the pump body and piston. In addition any particles that may have become lodged between the piston and the pump body while the piston is stationary are picked up by such liquid flow to be carried away from the portions which are in sliding engagement with each other.

The pivotal connection provided between the piston 18 and the pull rod 19 assists in preventing misalignment of the piston as a result of any misalignment of the free end of the pull rod which may be caused during reciprocation of the pull rod or as a result of misalignment of the bore hole in which the pump is located.

In addition the pull rod 19 is tubular and air tight whereby it is rendered buoyant in the liquid being carried up the tubular body. Such buoyancy serves in assisting the upstroke of the piston during which time the liquid contained in the tubular body above the piston is being

lifted by the piston. In addition the volume of the pull rod occupies a significant portion of the volume of the tubular housing as a result of the relative cross sectional areas of each. As a result the pull rod will displace liquid from the tubular body during its downstroke into the tubular body to provide a delivery of liquid from the upper end of the tubular body during such downstroke provided the tubular body is full prior to commencement or becomes full during such downstroke.

The second embodiment as shown at Figures 3 and 4 is of a similar form to the first embodiment the difference between the embodiments resides in the piston 18 which is of a tubular configuration and has a substantially uniform cylindrical outer configuration whereby the outer face is closely spaced from the inner face of the tubular body to provide a restricted flow pathway therebetween. The other end of the piston remote from the pull rod 19 supports an annular seal 27 which sealingly and slidingly engages the main wall of the tubular body. The internal face of the other end of the piston is formed with an annular flange to provide a valve seat 23 for the ball valve 24 located within the piston. The one end of the piston is partially closed by the closed end of the pull rod 19 which pivotally supports the piston through a pivot pin 20. Slotted apertures 25 are provided in the walls of the piston. During reciprocation of the piston the resultant fluid flow through the piston from the pumping chamber passes both from the one end of the piston between the inner face of the piston and the pull rod and also between the space defined between the internal bore of the tubular body and the external face of the piston.

It should be appreciated that the scope of the present invention need not be limited to the particular scope of the embodiment described above.

THE CLAIMS defining the invention are as follows:-

1. A pump having a pump body a piston slidably received therein to define a pumping chamber whereby the volume of the pumping chamber is varied with reciprocation of the piston in the pumping chamber, a seal supported by the piston for sliding and sealing engagement with the pump body, said piston accommodating a non return valve which allows the flow of liquid through the piston when the volume of the pumping chamber is being reduced by movement of the piston and which delivers liquid from the pumping chamber into a space between a piston and the internal walls of the pump body downstream from the seal, said space providing a restricted passageway opening into the pump body downstream from the piston whereby the liquid flow through the space during reciprocation of the piston is turbulent and of relatively high velocity.

2. A pump as claimed at claim 1 wherein the piston is pivotally mounted to the end of a pull rod.

3. A pump as claimed at claim 1 or 2 wherein the outer wall of the piston is concentric to the internal wall of the pump body.

4. A pump as claimed at claim 3 wherein the piston is formed with a central axial passageway which accommodates the non return valve, the outer face of the piston is formed with a waisted portion downstream from the seal and has a first set of openings provided in the waisted portions to communicate with the downstream side of the one way valve and the second set of passageways formed in the piston body downstream from the waisted portion to permit fluid flow from the waisted portion.

5. A pump as claimed at claim 4 wherein said second passageways comprise at least one flute in the outer face of the piston body downstream from the waisted portion.

6. A pump as claimed at any one of the preceding claims wherein the pump comprises a bore hole lift pump.

7. A pump as claimed at claim 6 wherein the pump body is formed by the lower end of a tube accommodating the pull rod and through which the liquid exiting the pump is raised.

8. A pump as claimed at any one of the preceding claims wherein the pull rod is bouyant in the liquid.

9. A pump as claimed at any one of the preceding claims wherein the pull rod has a cross sectional area which occupies a significant portion of the cross section area of the tube.

10. A pump as claimed at any one of the preceding claims wherein the pull rod is tubular.

11. A pump substantially as herein described.

12. A piston of a lift pump said piston having a substantially tubular configuration and having an external configuration similar in shape to the internal configuration of the pump body but being of reduced dimensions, one end of the piston being adapted to be pivotally mounted to a pull rod and to provide a clearance between the pull rod and the internal face of the piston the other end of the piston supporting around its exterior a seal adapted for sliding sealing engagement with the pump cylinder wall and at its interior a valve seat, a

ball valve received within the body between the valve seat and the pull rod and apertures provided through the walls of the piston between the seal and the one end thereof.

13. A pump piston substantially as herein described.

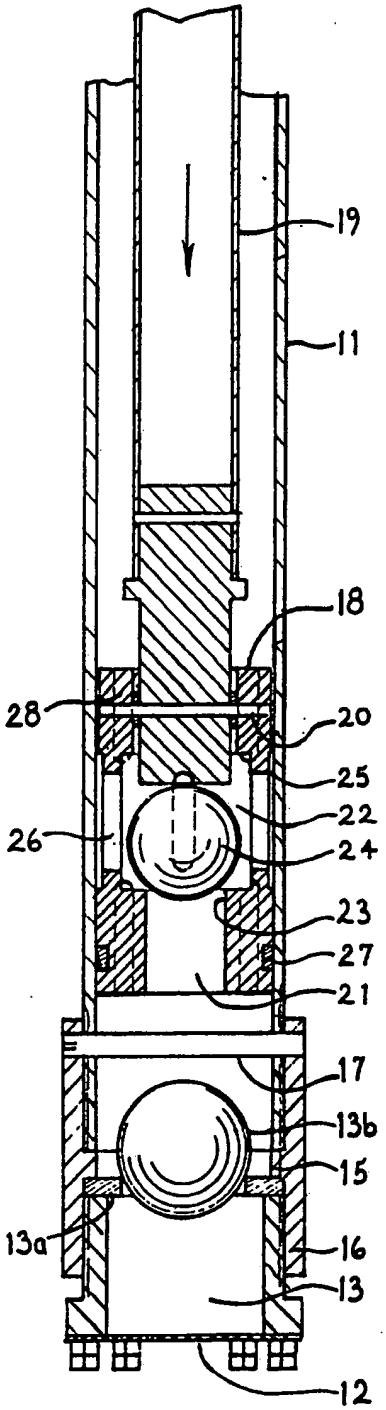
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Fig. 1

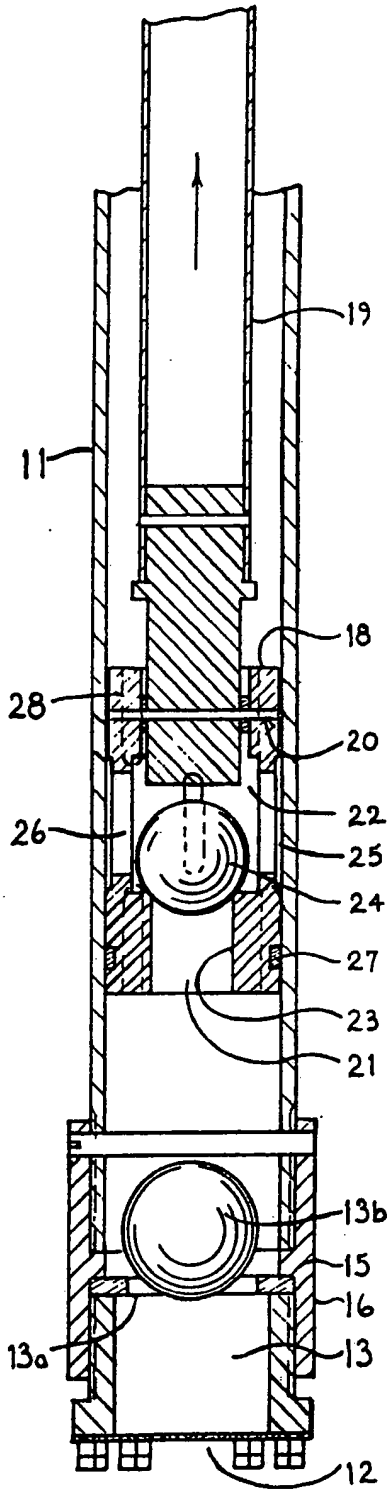
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Fig. 2

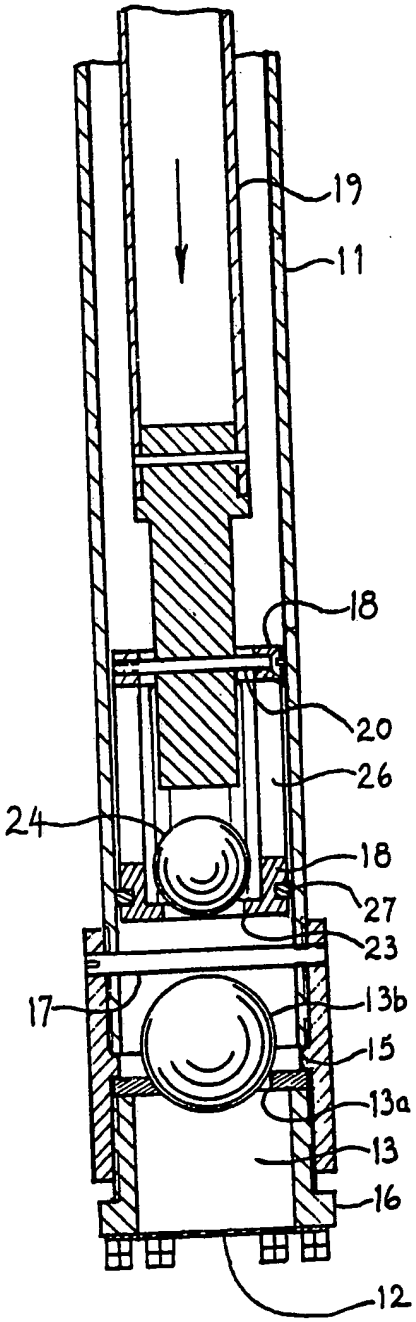

Fig 3

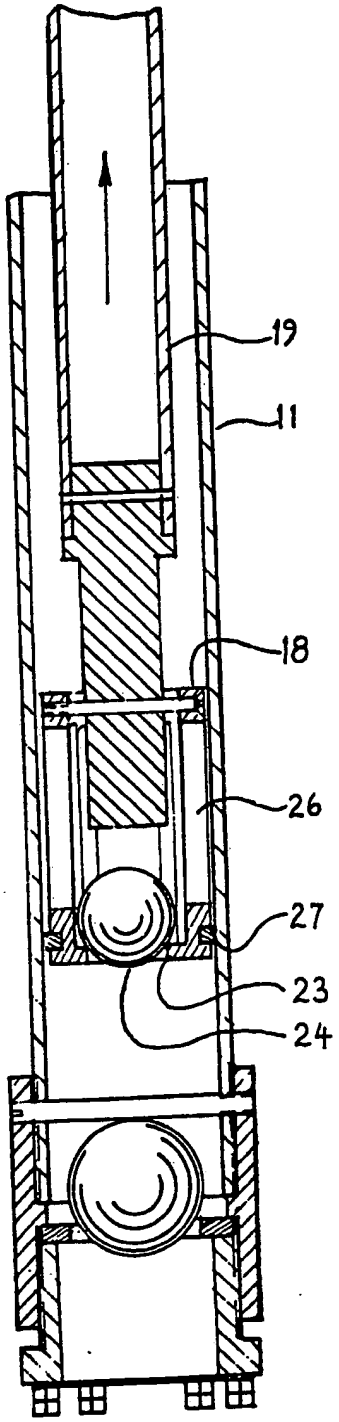

Fig 4

INTERNATIONAL SEARCH REPORT

International Application No PCT/AU 89/00074

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[4] F04B 47/02, 21/04

II. FIELDS SEARCHED

Minimum Documentation Searched †

Classification System	Classification Symbols
IPC	F04B 47/02, 21/04

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched ‡

AU: IPC as above, Australian Classification 68.5, 68.3

III. DOCUMENTS CONSIDERED TO BE RELEVANT §

Category *	Citation of Document, ** with indication, where appropriate, of the relevant passages ††	Relevant to Claim No. ‡‡
X,Y	US,A, 3089429 (MASSEY) 14 May 1963 (14.05.63)	(1-13)
X,Y	US,A, 3773437 (SUMAN) 20 November 1973 (20.11.73)	(1-13)
X,Y	US,A, 3822970 (SMITH et al) 9 July 1974 (09.07.74)	(1-13)
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A	GB,A, 2070697 (POLYNERGIE (1980) INC.) 9 September 1981 (09.09.81)	
X,Y	AU,B, 11625/52 (158775) (GEARING & JAMESON LTD) 2 October 1952 (02.10.52)	(1-13)
A	Derwent Abstract Accession No. 87-149365/21, Class Q56, SU,A, 1262109 (AZERB PETRO IND.) 7 October 1986 (07.10.86)	
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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
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International Searching Authority	**Signature of Authorized Officer**
Australian Patent Office	C.M. WYATT

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